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Weapons Systems in an Air Defense Artillery
Command and Control System

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A Way to Control Medium and Low Range Weapons Systems in an Air Defense Artillery Command and Control System

Juan Díez Pantaleón
INDRA EWS
Joaquín Rodrigo, 11
28300 ARANJUEZ-MADRID-SPAIN
jdpantaleon@indra.es

1   Summary

When an Air Defense Artillery (ADA) commander receive the order to defend an area o high value point he also receives the list of ADA units that can be employed. He will never receive the appropriate resources he would like to have.

The most common problem arised to the ADA commander is to manage different kinds of weapons systems (medium, short and very short ranges) given for air defense purposes.

To integrate subordinate Fire Direction Centers (FDC,s) and the various weapons systems in a single ADA Command and Control (C2) Fire Direction Center (FDC) is a real problem.

Functions providing control of weapons require some ideas to be presented in this paper.

The national weapons systems integration can be easily managed.

Non national resources could be integrated if some software and communication problems could be solved.

2   Introduction

Air Defense employment principles are relevant in an ADA C2 system concept. Principles such as mass, mix, mobility and integration have been columns which support the system concept.

Integration, as an operational effectiveness maximizer, is the principle to which more pages are dedicated in this paper.

As System Concept, *mass* implies having an adequate number of weapons systems according to present engagement requirements and future needs.

The main constraints to this number come from communication performances and exchange information needs.

As System Concept, *mix* implies having a variety of weapons systems going from medium SAM (MSAM) to very short range (VSHORAD) systems, and subordinates ADA C2 FDC,s which have weapons systems mixture.
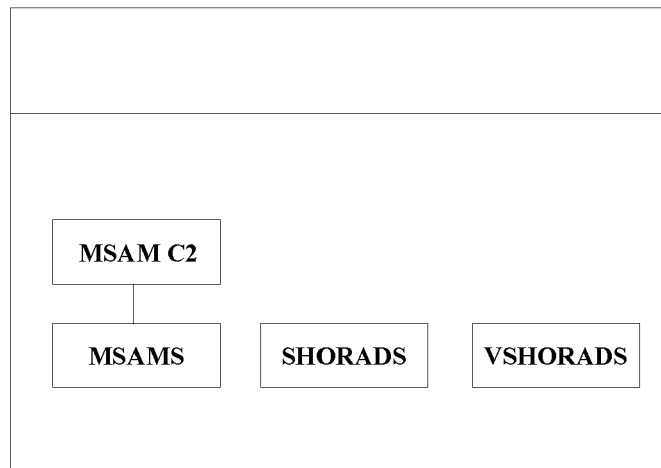
The term *control*, in this paper, should be interpreted as *target assignment to a weapon system*.

3   National historical perspective

National capabilities in terms of Air Defense Artillery history are explained below.
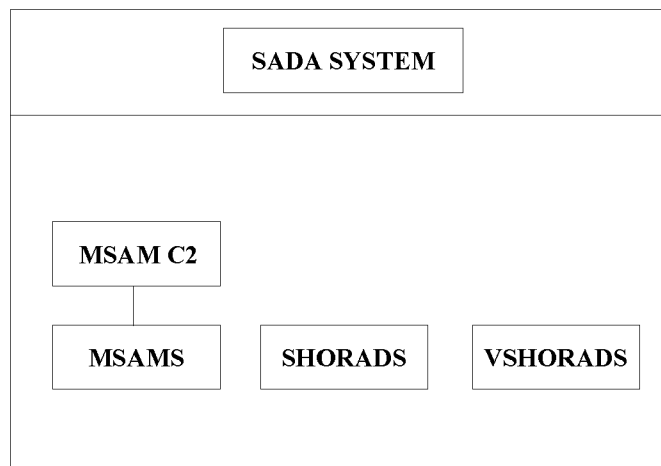
Very short range (VSHORAD) and short range (SHORAD) weapons systems have been in the inventory for a long time period.

In 1965 Army ADA arrived to the medium range (MSAM) theater with integration capability (C2) to control this weapons systems.

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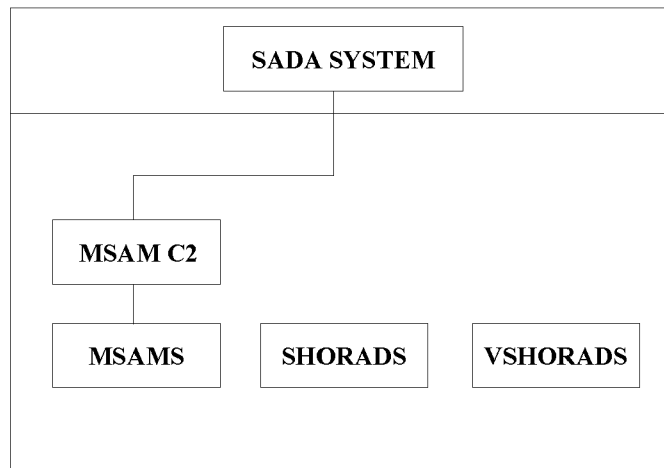
In 1972, Army ADA incorporated a long range unit and acquired integration capability (C2) to control this weapon system.
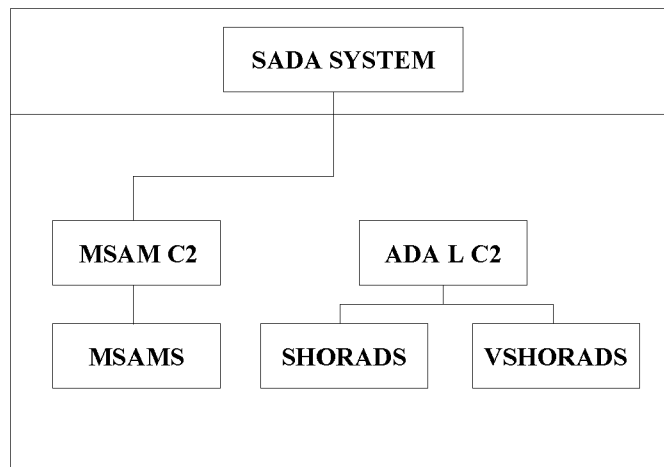
In 1975, Air Force finalized one phase of Combat Grande Program, which allowed to have an Air Defense Semiautomatic System (SADA) able to integrate ADA Command and Control Systems.

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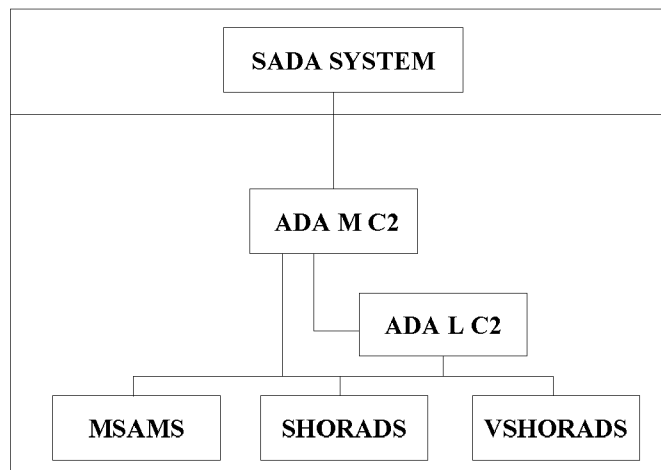
In 1984, Army ADA Command and Control Fire Direction Center for medium range was integrated by data link in SADA allowing to integrate MSAM units in the Air Defense.

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|              |   SADA SYSTEM   |              |
|              +-----------------+              |
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|          +-------------+                      |
|          |  MSAM C2  |                        |
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|        +-----------+  +-----------+  +-----------+
|        |   MSAMS   |  |  SHORADS  |  | VSHORADS  |
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In 1997, Army ADA Command and Control Fire Direction Center prototype for Very Short and Short Range Weapons Systems (ADA L C2- COAAASL) was delivered to Army Units for trials finishing in a serial production.

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|   |  MSAM C2  |           |  ADA L C2 |        |
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|   |   MSAMS   |   |  SHORADS  |  | VSHORADS  | |
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In 2000, Army ADA Command and Control Fire Direction Center prototype for Medium, Short and Very Short Range and ADA L C2 FDC (ADA M C2- COAAASM) will be available. At that moment any national weapon system in inventory will be integrated in Army ADA C2 and in Air Defense (SADA).

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In the near term, interoperability between ADA M C2 and other non national Command and Control System will be achieved.

4   Problem presentation

To control (engage a target by a fire unit) a mass/mix of weapons systems and subordinates ADA C2, is the problem at which this paper is dedicated.
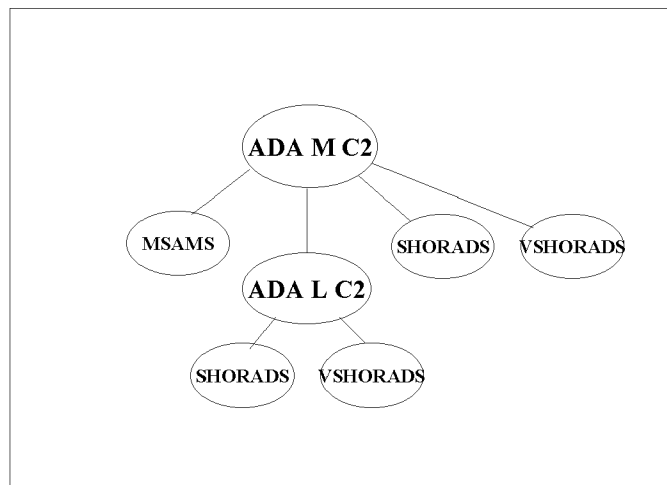
5   The way to control

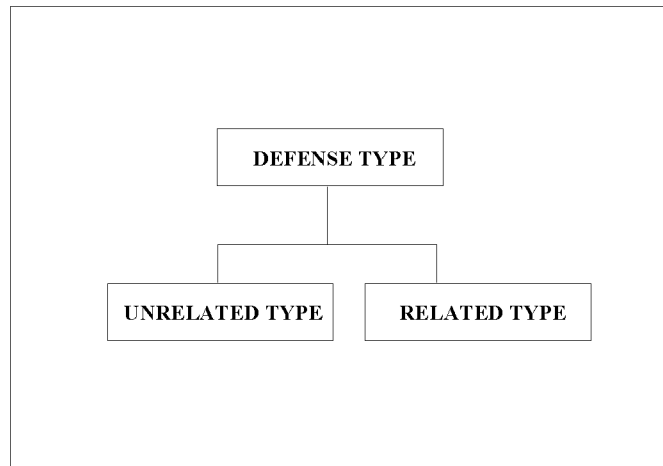In order to implement the control of weapons systems the following main functions have to be addressed:

- Defense Type
- Threat Evaluation
- Weapons Management
- Weapons Assignment

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│              │  THREAT EVALUATION  │                 │
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│                        │      │    WEAPONS       │   │
│                        │      │   MANAGEMENT     │   │
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│              │   WEAPONS ASSIGNMENT     │            │
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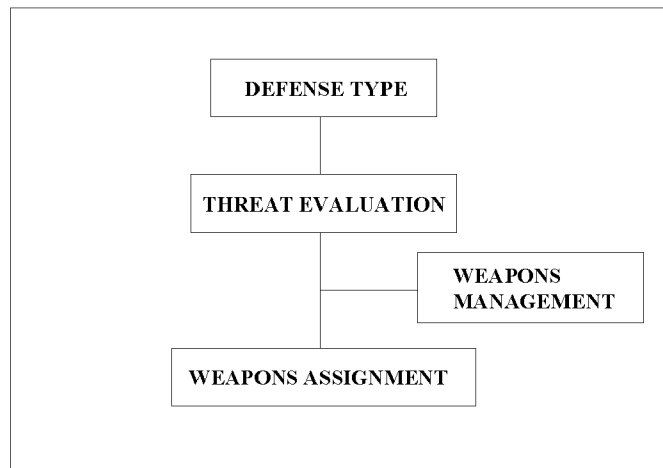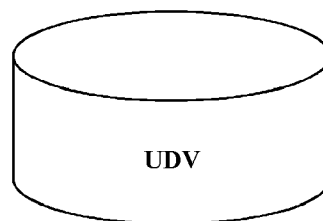
6 Defense Type

The primary decision is to standardize the types of defense the C2 must deal with. The family approach can be explored:

- Unrelated defense type
- Related defense type

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6.1 Unrelated Defense

The Unrelated Defense is the airspace zone that can be associated to a sole volume (UDV).

6.2 Related Defense

Airspace zones that can be associated to a family of volumes form the Related Defense. The family of volumes can be made up by:

- A Main Defense Volume (MDV)
- Several Child Defense Volumes (CDV,s) into each MDV
- Several Grandchild into each CDV (if required)
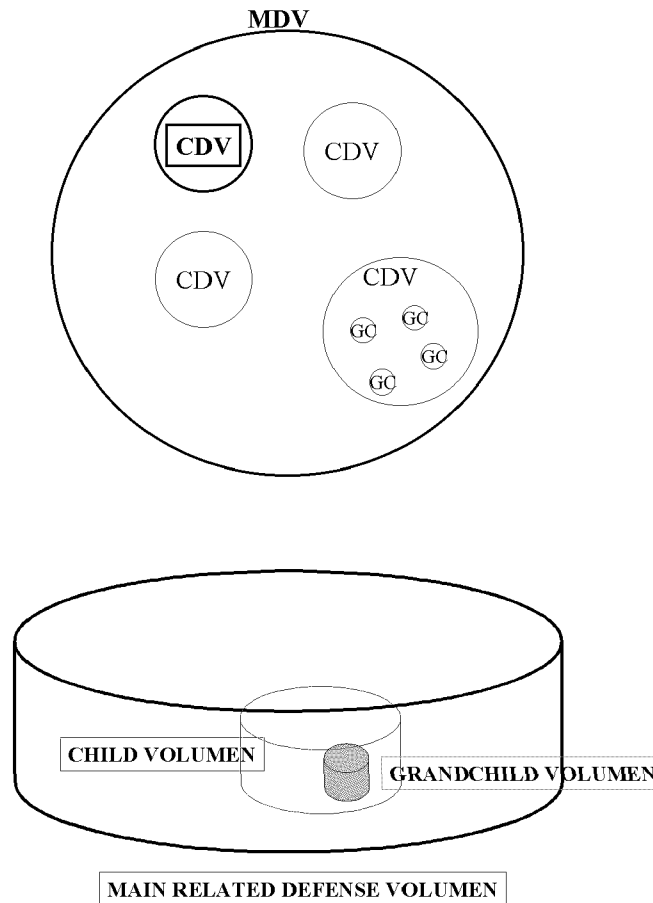
7 Threat Evaluation

The Threat Evaluation function shows how a target position in the airspace is threatening the defense type. Its process can be divided in two steps:

- To design Threatening Position Zones (TPZ)
- To define a Threat Priority List (TPL) of each Zone

7.1 Threatening Position Zone (TPZ)

According to the expected threat it is useful to design - around and inside the Defense Volume (sole or family) - airspace zones where the target positioning must be avoided. If a subdivision in altitude is taken into account, this design will provide a partitioned airspace where the threat is grows more threatening as it enters in the defense volume.
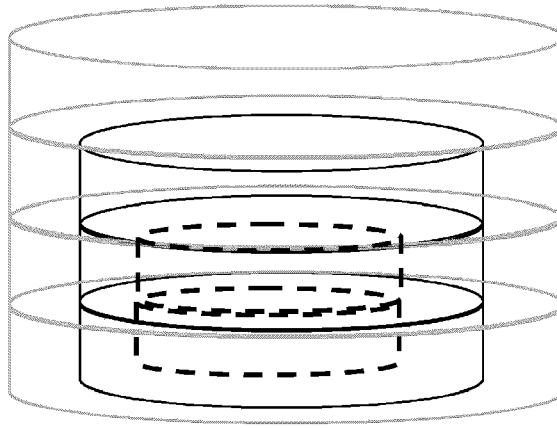
THREATENING POSITION ZONES

H4	TPZ				
H3	TPZ	TPZ	TPZ	TPZ	TPZ
H2	TPZ	TPZ	TPZ	TPZ	TPZ
H1	TPZ	TPZ	TPZ	TPZ	TPZ

The number of suggested zones for a Defense Volume is:

- Unrelated Defense Volume:
  - Several External Zones
  - One Internal Zone

- Main Defense Volume:
  - Several External Zones
  - One Internal Zone

- Child Defense Volume:
  - One External Zone
  - One Internal Zone

- Grandchild Defense Volume:
  - One Zone

7.2   Threat Priority List (TPL)

It is essential to obtain for each Threatening Position Zone (TPZ), the list of targets that are moving to occupy a position into the zone and listing them on a threat decision logic basis:

- Platform type and weapons associated

- Target cinematic

- Etc

8   Weapons Management

Weapons Management deals with a mass/mix of weapons systems. The most important lines of this function are:

- Weapons types to be employed

- Parameters to define this weapons

- Interchanged parameters by data link

8.1   Weapons types to be employed

In this context, a certain number of subordinate units:

- Medium range weapons

- Short Range weapons

- Very Short Range weapons

- Subordinates ADA C2 FDC,s

can be integrated.

8.2   Parameters to define weapons

Parameters associated to the Weapons Management function in order to obtain an Optimal Engagement Plan are as follows:

- Location and type of weapon system

- Primary and secondary TPZ,s

- Maximum effort permitted by TPZ

- Intercept volume

- Weapon speed

- Reaction time

- Compatible type of threat

- Maximum number of engagements

Subordinate ADA C2 can be transformed in a **Special Weapon** before becoming an engageable fire unit. The transformation can be made providing such a special weapon with values according to the SHORADS/VSHORADS under its control in the before mentioned parameters.

8.3   Interchanged parameters by data link

As a minimum, the following parameters are needed:

- Weapons status

- Weapons control status

- Fire control orders

8.4 Threatening Position Zones (TPZ)

Due to in that moment the commander knows the mass and the mix of weapons, he can redefine the Threatening Position Zones (TPZ) to a number more appropriate in order to reduce the amount of Threat Priority Lists (TPL) to play.
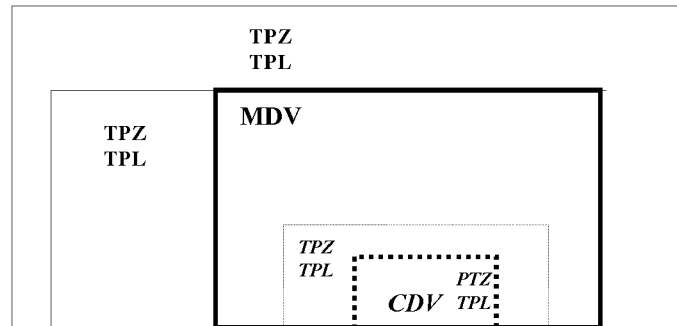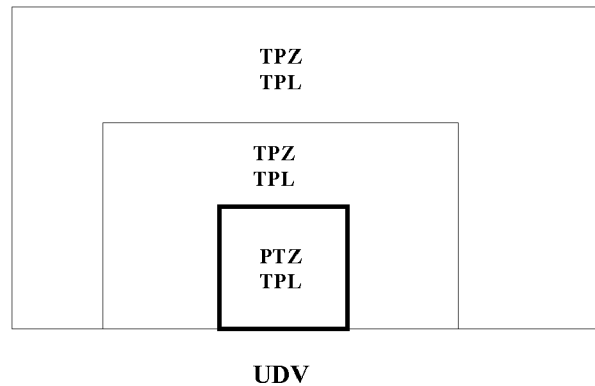
9   Weapons Assignment

In both defense types, the Engagement Plan for each Threat Priority List can employ the following process.

- To determine those weapons systems which are able to counter the threat

- To select the weapon system which can destroy the threat in the minimum time
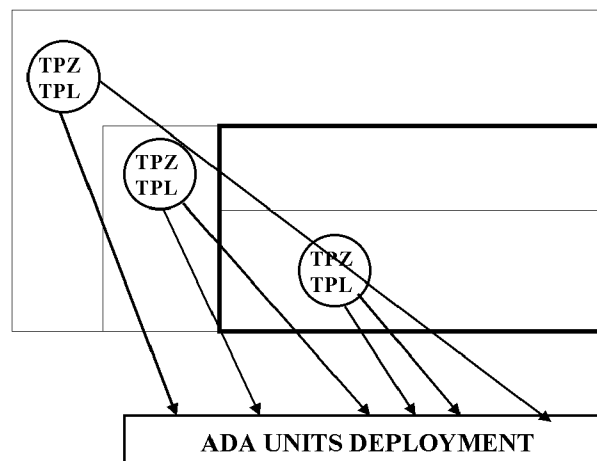
10 National Weapons Systems

A Combat Net Radio (CNR) and Weapons Terminals provide for the integration of SHORADS and VSHORADS (for warning, cueing and weapons assignment).

A Combat Net Radio (CNR) and standard data links provide for the integration of MSAM Weapons Systems.

11 Non national Weapons Systems

The employment of the same CNR and Weapons Terminals would permit the integration of non-national SHORADS and VSHORADS without changes in doctrine and procedures (for warning and weapons assignment) adapting certain parameters in the weapons terminals (minor software changes).

If MSAM non-national units have the same standard data links, the integration of this type of weapons systems is also possible.

12 Conclusions

Integration of SHORAD and VSHORAD weapons systems (national or non-national) is a real capability at this moment.

Integration of national MSAM SHORAD and VSHORAD weapons systems (directly or through ADA L C2) is no longer a concern.

Integration of national Army Air Defense in Air Defense is no longer a concern.

Interoperability between ADA M C2 will be a challenge to be solved in the near term.

References

(1) US Army Air and Missile Defense Operations (FM 44-100)

(2) National Fire Directions Centers Programs bibliography